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BY

GEORGE M. STERNBERG, M. D., LL. D.,
Surgeon-General, United States Army.

FROM THE SMITHSONIAN REPORT FOR 1895, PAGES 781-786.

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A faint, light-colored watermark or background image of a classical building with four prominent columns and a triangular pediment is visible across the entire page.

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By GEORGE M. STERNBERG, M. D., LL. D.,
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LADIES AND GENTLEMEN: I am to speak to you of the life and achievements of one who has won imperishable renown by his valuable contributions to human knowledge, and who has recently been buried in the city in which his scientific labors have been prosecuted, with all the honors which it was possible for a grateful people to confer. It is certainly a happy augury for the future when the man of science, whose achievements have been the result of painstaking and laborious work in the laboratory, receives the grateful plaudits of his fellow-men during his lifetime and the honors which were formerly only paid to civil potentates or military heroes when his body is committed to the tomb. It has been the fortune of few men to contribute so largely to the sum of useful knowledge, and fewer still have lived to receive such ample recognition of the value of their scientific work.

Pasteur's success has been due to a combination of personal qualities which especially fitted him for the pioneer work which he has done in his chosen field of scientific investigation. With that penetrating intellect and versatility of resource which constitutes genius, was combined an energy and persistence of purpose, a disregard of accepted theories not supported by evidence, and an appreciation of the value of the experimental method as the only reliable means of arriving at exact truth. No amount of conservative opposition intimidated him when he announced results obtained by his carefully conducted laboratory experiments, and no false pride seduced him into maintaining a position which he had once taken, if the experimental evidence was against him. This rarely happened. But where is the man of science who is infallible? Working in a new field, by methods largely of his own devising, which were necessarily more or less imperfect at the outset, it is surprising how few mistakes he made.

With his genius for scientific research, his indomitable perseverance, and the forceful character which enabled him to defend his discoveries

¹Memorial address delivered January 14, 1896, under the auspices of the Joint Commission of the Scientific Societies of Washington. Reprinted from *Science*. New series, Vol. III, No. 58, February 7, 1896.

so successfully, there must have been associated a kindly disposition, for those who were closely associated with him in his laboratory work were devotedly attached to him. He evidently had the faculty of inspiring others with his enthusiasm for science, and their loyalty to him and to their common mistress was rewarded by the frank acknowledgment on his part of their share in the work accomplished. So far as I am aware, he never showed any disposition to appropriate for himself credit due to another, whether that other was an associate or pupil in his own laboratory, or one who was prosecuting his investigations elsewhere. The speaker's personal acquaintance with Pasteur is limited to a memorable half day spent in his laboratory about ten years ago. Although still disabled to some extent by paralysis, resulting from his first apoplectic attack, he conducted me through his laboratory and with the greatest kindness explained to me the methods in use and the results recently accomplished in the lines of experimental work which at that time occupied the attention of himself and his colleagues.

The time at my disposal will permit only a brief review of the life and work of this illustrious savant; but this review will show that his scientific achievements are of the highest order, and that the practical benefits resulting from his labors have extended to all parts of the civilized world. He belongs not alone to France, but to science, and it is eminently fitting that we should pay a tribute to his memory in this capital city of a country in which his name is so well known and in which the results of his scientific investigations are so highly appreciated.

Louis Pasteur was born at Dôle, a small town in the Department of Jura, France, on the 27th of December, 1822; he died at his home in Garches, a suburb of Paris, on the 28th of September, 1895.

Pasteur's father had been a soldier in the army of Napoleon, but at the time of his famous son's birth was working at his trade as a tanner. In 1825 the family moved to Arbois, a small town in the same department, and here Louis Pasteur attended school at the collège communal. Later he was sent to the college at Besançon, where he took his degree of Bachelier des Lettres. He subsequently entered the École Normale of Paris, and while there devoted himself to his favorite study—chemistry. Three years after joining the École Normale he was appointed assistant professor of physical science. In 1848 he was appointed professor of physics at Dijon, and after a few months resigned his position for the chair of chemistry in the University of Strasburg. In 1854 Pasteur was induced to accept the position of dean of the newly created Faculty of Sciences at Lille, and in 1857 he returned to Paris as scientific director of the École Normale, where he had gained his first scientific laurels. In 1862 Pasteur became a member of the Institute, and in the same year he was appointed professor of geology, physics, and chemistry in the École des Beaux Arts. He was elected to the Academy of Sciences, taking the Fauteuil of Littré, in 1881. The same year

he received the Grand Cross of the Legion of Honor. In 1874 the National Assembly of France voted him a life pension of 20,000 francs annually. Upon the anniversary of his seventieth birthday, December 27, 1892, he received from his compatriots a superb ovation at the Sorbonne, which was attended by President Carnot, the members of the French Institute, all foreign ministers and ambassadors then at the French capital, and delegates from scientific societies in all parts of the world. The Pasteur Institute, established in his honor, was inaugurated with proper ceremonies on the 14th of November, 1888. It is situated in the rue Dutot, Paris, and is an imposing stone building in the style of Louis XIII. It was built and equipped from a fund raised by public subscription, amounting to 2,586,000 francs. Of this sum 200,000 francs was voted by the French Chambres Legislatif. After the completion and equipment of the building more than 1,000,000 francs remained as a permanent endowment.

The time at my disposal will permit of but a brief review of Pasteur's scientific achievements. After having made some notable discoveries in chemistry his attention was attracted to the minute organisms found in fermenting liquids, and by a brilliant series of experiments he demonstrated the fact that the chemical changes attending fermentation are due to the microscopic plants known as bacteria; also that different species give rise to different kinds of fermentation, as shown by the different products evolved during the process. In prosecuting these studies he discovered the species which produce lactic acid, acetic acid, and butyric acid, and he added largely to our knowledge relating to alcoholic fermentation and the class of micro-organisms to which it is due. He showed that in the absence of living organisms no putrefaction or fermentation can occur in organic liquids, and that these low organisms do not develop by spontaneous generation, as was at that time generally believed, but have their origin from preexisting cells of the same species, which are widely distributed in the atmosphere, especially near the surface of the earth. Various experimenters had shown that a development of bacteria sometimes occurs in boiled organic liquids excluded from the air. Pasteur showed that this was not due to spontaneous generation, but to the survival of the spores of certain species of bacteria. These are able to resist a boiling temperature without loss of vitality and reproductive power.

In 1865 the distinguished French chemist Dumas invited his former pupil, Pasteur, to make investigations with reference to the cause and prevention of a fatal malady among silkworms, which threatened to destroy the silk industry of France. In the course of an investigation which occupied several years, Pasteur succeeded in demonstrating the nature of the infectious malady known as pébrine, the mode of its transmission, and the measures necessary to eradicate it. Following his advice the growers of silkworms succeeded in banishing the scourge, and within a few years the industry was reestablished upon its former profitable footing.

This pioneer work led to further investigations with reference to the cause and prevention of certain infectious diseases of the lower animals, and especially to the fatal disease of cattle and sheep known as anthrax. Having satisfied himself that this disease is due to a bacillus, which is found in great numbers in the blood of infected animals, he demonstrated by experiment that this bacillus rapidly loses its virulence when cultivated in artificial media at a temperature of 42° to 43° C. Also that animals inoculated with this "attenuated" virus suffer a mild attack of the disease, and that after their recovery they are immune against future attacks, even when inoculated with the most virulent material. This discovery has been applied practically, on an extensive scale, in France, Austria, Switzerland, and other European countries. The result of anthrax inoculations made by Pasteur's method in France during the past twelve years was summarized by Chamberland in 1894. He reports the total number of animals inoculated during this period as 1,788,677 sheep, and 200,962 cattle, and estimates the total saving as the result of the inoculations as 5,000,000 francs for sheep and 2,000,000 francs for cattle.

Another infectious disease in which Pasteur's method has been employed with success is rouget or hog erysipelas. Chamberland states that as a result of the protective inoculations practiced with Pasteur's vaccines the mortality from this disease in France has been reduced from about 20 to 1.45 per cent. Hutyra reports that during a single year (1889) 48,637 pigs were inoculated with Pasteur's vaccines in Hungary with a loss of 0.29 per cent, while the losses upon the same farms in previous years averaged from 10 to 30 per cent.

But we must pass to that portion of Pasteur's scientific work which has most engaged the attention of the public. Pasteur first announced his success in reproducing hydrophobia in susceptible animals by inoculations of material obtained from the central nervous system in a communication made to the Academy of Sciences on May 30, 1880. Continuing his investigations he reported, in 1884, his success in conferring immunity against hydrophobia in nineteen dogs inoculated, in the presence of a commission appointed for the purpose, as a test experiment. These animals had been rendered refractory by his method. The nineteen protected animals and nineteen control animals obtained from the public pound without any selection were tested at the same time. The test was made upon some of the animals of both series by inoculation with virulent material upon the surface of the brain, and upon others by allowing them to be bitten by rabid dogs, and upon still others by intravenous inoculations. Not one of the protected animals developed hydrophobia; on the other hand, three of the control animals out of six bitten by a mad dog developed the disease, five out of seven which received intravenous inoculations died of rabies, and five which were trephined and inoculated on the surface of the brain died of the same disease.

With reference to his first inoculations in man, Pasteur says:

"Making use of this method, I had already made fifty dogs of various races and ages immune to rabies, and had not met with a single failure, when, on the 6th of July, quite unexpectedly, three persons, residents of Alsace, presented themselves at my laboratory."

These persons were Theodore Vone, who had been bitten on the arm on July 4, Joseph Meister, aged 9, bitten on the same day by the same rabid dog, and the mother of Meister, who had not been bitten. The child had been thrown down by the dog and bitten upon the hand, the legs, and the thighs, in all in fourteen different places. Pasteur commenced the treatment at once, and had the satisfaction of reporting to the Academy of Sciences in March of the following year (1886) that the boy remained in perfect health. Since this time Pasteur institutes for the treatment of hydrophobia have been established in all parts of the civilized world, and the statistical reports published justify the belief that when the treatment is instituted at an early date after the bite, and is properly carried out, its protective value is almost absolute. At the Pasteur Institute in Paris, 9,433 persons were treated during the years 1886 to 1890, inclusive. The total mortality from hydrophobia among those treated was considerably less than 1 per cent (0.61). In 1890, 416 persons were treated who had been bitten by animals proved to be rabid, and among these there was not a single death. In 1891 the number of inoculations was 1,539, with a mortality of 0.25 per cent; in 1892, 1,790, with a mortality of 0.22 per cent; in 1893, 1,648, with a mortality of 0.36 per cent; in 1894, 1,387, with a mortality of 0.50 per cent.

There has been and is still a considerable amount of skepticism among members of the medical profession and others as to the practical value of Pasteur's inoculations for the prevention of hydrophobia; and some physicians have even contended that the disease known by this name is not the result of infection from the bite of a rabid animal, but is a nervous affection due to fear. The time at my disposal will not permit me to present for your consideration the experimental and clinical evidence upon which I base the assertion that nothing in the domain of science is more thoroughly demonstrated than the fact that there is a specific infectious disease known to us as rabies, or hydrophobia, which may be communicated to man, or from one animal to another, by the bite of a rabid animal, and that Pasteur's inoculations prevent the development of the disease in animals which have been infected by the bite of a rabid animal or by inoculations with infectious material from the central nervous system. This being the case, it is evident that there is a scientific basis for Pasteur's method of prophylaxis as applied to man, and his published statistics give ample evidence of the success of the method as carried out at the Pasteur Institute in Paris and elsewhere. Great as have been the practical results which have already followed Pasteur's brilliant discoveries,

there is reason to believe that in the future still more will be accomplished, especially in combating the infectious diseases of man. Having pointed out the way, a multitude of earnest investigators in various parts of the world are now engaged in laboratory researches relating to the cause, prevention, and cure of infectious diseases. Already, in the treatment of diphtheria and of tetanus with blood serum obtained from immune animals, results have been obtained of the highest importance, and it seems probable that in the near future other infectious diseases will be cured by a specific treatment based upon scientific information obtained by those who have been following in the pathway marked out by Pasteur, the illustrious pioneer in this line of research.

